MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

DIM5058 – MATHEMATICAL TECHNIQUES 1

(For DIT students only)

15 OCTOBER 2018
02.30 pm - 04.30 pm
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **4** pages (**2** pages with **5** questions and **2** pages of appendix). Key formulae are given in the Appendix.
2. Answer **ALL** questions.
3. Write your answers in the answer booklet provided.
4. All necessary working steps must be shown.

Question 1

a) Simplify $\sqrt[3]{64x^3y^6} \times \frac{1}{\sqrt[3]{8x^6y^{-9}}}$ and give your answer in **positive exponent.**

(4 marks)

b) Solve for x of the given equations.

i) $\frac{3x}{5} \div \frac{2x}{15} = 7x$. (3 marks)

ii) $\sqrt{5x-4} = -x$. (3 marks)

c) Given that $\frac{70}{x} = 2x - 4$, find the discriminant and state the type of solutions for the equation. Hence, solve for x by using **quadratic formula.** (5.5 marks)

d) Solve the inequality $\left|\frac{13+2x}{11}\right| < 7$ and represent the answer in interval notation.

(4.5 marks)

[TOTAL 20 MARKS]

Question 2

a) Given that $p(x) = 3 - 2x$ and $q(x) = 4x^2 + 5x - 3$, find $(q \circ p)(x)$. (4 marks)

b) Find the inverse function of $h(x) = -\sqrt[4]{3x-6} + 5$. Hence, evaluate $h^{-1}(2)$.

(6 marks)

[TOTAL 10 MARKS]

Question 3

Given a quadratic function $f(x) = (3-x)(-2-x)$.

a) Determine whether the parabola opens upward or downward. (1 marks)

b) Find the vertex of the parabola. (3 marks)

c) Find the y-intercept. (2 marks)

d) Given that the x-intercepts are 3 and -2, sketch the parabola and label the necessary points. (4 marks)

[TOTAL 10 MARKS]

Continued...

Question 4

a) Given that $A=\begin{pmatrix}-4 & 0 & 1\\ 0 & 2 & 3\\ -5 & 2 & 0\end{pmatrix}$ and $B=\begin{pmatrix}2 & 1 & -2\\ 3 & -6 & 1\\ 4 & 0 & 4\end{pmatrix}$.

i) Show that $(2A+3B)^T=\begin{pmatrix}-2 & 9 & 2\\ 3 & -14 & 4\\ -4 & 9 & 12\end{pmatrix}$. (5 marks)

ii) By using the answer in part 4a(i), find the determinant of $(2A+3B)^T$. (2.5 marks)

b) James and Chandran played video racing games and table soccer games. James spent RM27 for 3 racing video games and 4 table soccer games while Chandran spent RM31 for 5 racing video games and 2 table soccer games. [Hint: Let x and y be the price of racing video games and price of table soccer games respectively.]

i) Represent the above information in matrix form, $AX = B$. (1 mark)

ii) From part 4b(i), determine the price of each video racing game and table soccer game. **[Hint: Use inverse matrix method]** (6.5 marks)

c) Solve the system of equations given by using **Cramer's Rule**. (15 marks)

$$\begin{cases} -x+3y=-72 \\ 3x+4y-4z=-4 \\ -20x-12y+5z=-50 \end{cases}$$

[TOTAL 30 MARKS]

Question 5

a) Find the sum for $\sum_{k=2}^{7}\frac{(-4+k)^k}{(k-1)!}$. (4 marks)

b) The 7th term of an arithmetic sequence is 165 and the 23rd term is 533.

i) Find the first term and common difference. (6 marks)

ii) Find the value of n if the sum of the first n^{th} terms is 2820. (6 marks)

c) A virus reproduces by dividing into two, and after a certain growth period, it divides into two again. As the virus continues to reproduce, it will continue to divide in two. Given that the sequence is a geometric sequence.

i) State the first term, a and the common ratio, r. (2 marks)

ii) How many viruses will be produced in the 10^{th} divisions? (2 marks)

iii) Find the total of the viruses produced after 10 divisions. (2 marks)

d) Expand $(x^3-2y)^5$. (8 marks)

[TOTAL 30 MARKS]

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APPENDIX – KEY FORMULA

Inequalities:

Inequality	*Solution*
$\|x\| < a$	$-a < x < a$
$\|x\| \leq a$	$-a \leq x \leq a$
$\|x\| > a$	$x < -a \quad or \quad x > a$
$\|x\| \geq a$	$x \leq -a \quad or \quad x \geq a$

Completing the square: $x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(x + \frac{b}{2}\right)^2$

Quadratic formula: If $ax^2 + bx + c = 0$ where $a \neq 0$, then, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Standard form of a quadratic function: $f(x) = a(x-h)^2 + k$, $a \neq 0$

Determinant of a 2 × 2 matrix	*Determinant of a 3 × 3 matrix*
$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1 b_2 - a_2 b_1$	$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ $= a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$

Inverse of a 2 × 2 matrix

If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$,

then $A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$,

where $ad - bc \neq 0$.

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Cramer's Rule for 2 × 2 matrix	*Cramer's Rule for 3 × 3 matrix*
If $\begin{aligned} a_1x+b_1y&=c_1 \\ a_2x+b_2y&=c_2 \end{aligned}$ then $x=\dfrac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$ and $y=\dfrac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$, where $\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} \neq 0$	If $\begin{aligned} a_1x+b_1y+c_1z&=d_1 \\ a_2x+b_2y+c_2z&=d_2 \\ a_3x+b_3y+c_3z&=d_3 \end{aligned}$ then $x=\dfrac{D_x}{D}$, $y=\dfrac{D_y}{D}$, $z=\dfrac{D_z}{D}$ where $D=\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$, $D_x=\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}$, $D_y=\begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}$, $D_z=\begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$

Arithmetic sequence	*Geometric sequence*
$a_n=a_1+(n-1)d$	$a_n=a_1r^{n-1}$, $S_n=\dfrac{a_1(1-r^n)}{1-r}$
$S_n=\dfrac{n}{2}(a_1+a_n)$	$S_\infty=\dfrac{a_1}{1-r}$, $\lvert r\rvert<1$

Binomial Theorem

$$(a+b)^n=\sum_{k=0}^{n}\binom{n}{k}a^{n-k}b^k;\quad n\geq 1$$

The r^{th} term of the expansion of $(a+b)^n$ is $\binom{n}{r-1}a^{n-r+1}b^{r-1}$.

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